

Appl. No. 09/625,710
Amdt. Dated August 28, 2003
Reply to Office Action of June 30, 2003

REMARKS/ARGUMENTS

1. In the final Office Action dated June 30, 2003 ("the Office Action"), the claims stand rejected under 35 U.S.C. §103(a). Applicant respectfully requests entry of the foregoing amendments, consideration of the following remarks and arguments, withdrawal of the rejections, and allowance of the claims.

Status of the Claims

Claims 1-7, 13, 14, 18-20 and 24 have been previously canceled.

Claim 28 is presently canceled.

Claims 8, 11, 12, 21 and 26 are currently amended.

Claims 8-12, 15-17, 21-23 and 25-27 are currently pending.

SUMMARY OF EXAMINER INTERVIEW

2. Applicant gratefully acknowledges the interview granted by Examiner Doroshenk on August 14, 2003 to the undersigned agent. Applicant concurs with the Examiner's Interview Summary mailed August 15, 2003. In the interview, the pending claims and the *DeJong et al.*, *Kiliany et al.*, *Heisel et al.*, and *Heck et al.* references in particular were discussed. A sulfur vapor pressure/condensation curve and sulfur recovery background from a published Engineering Data Book, Gas Processors Association, Tulsa Oklahoma, p. 22-1 and 22-19 (1998), presented by Applicant, was discussed. The Examiner noted that amendment of Fig. 1 to include reference number 10 was needed, that the specification at page 9, line 6 required correction of an apparent typographical error by which the catalyst structure is erroneously referenced as "10" instead of "24"; and she further suggested making clarifying amendments to claims 21 and 26. It was agreed by the Examiner and the undersigned that it appears that a condensable amount of sulfur would not be made in the process of *DeJong et al.*, and that the combinability of the references will be reconsidered in light thereof, upon receipt from Applicant of a reply to the Office Action including: a) the sulfur vapor pressure/condensation evidence, b) clarifying amendments to claims 8, 11, 12, 21 and 26; and c) corrected drawings, as discussed.

Correction to the Specification

3. The above-described typographical error noted by the Examiner has been corrected in the specification.

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Correction of the Drawings

4. Fig. 2 is corrected herewith to insert reference number "10" in conformity with the specification at page 10, line 9.

Rejections Under 35 U.S.C. § 103(a)

5. In the final Office Action dated June 30, 2003, claims 8, 15, 17, 21, 22 and 25 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *DeJong et al.* in view of *Kiliany et al.* "as presented in paragraph 3 of Paper No. 16." It appears that the reference to Paper No. 16 is a typographical error and that "Paper No. 13" was intended, i.e., the previous Office Action dated December 17, 2002.

The *DeJong et al.* Patent Fails as the Primary Reference

6. The final Office Action maintains the position that, as the primary reference, *DeJong et al.* teach a reaction zone (Fig. 1, ref. no. 2), and a catalyst (at col. 4, lines 1-6), at least one cooling zone downstream from the reaction zone (col. 8, lines 4-12), and a sulfur removal unit (Fig. 1, ref. no. 22). However, the Office Action fails to take into account the requirement in claim 8 that the cooling zone includes a sulfur condenser. From the express teachings of *DeJong et al.*, it can be immediately recognized that the cooling zone (heat exchanger 10) of *DeJong et al.* is distinct from the desulfurization unit 22. *DeJong et al.*, state at col. 8, lines 4-12,

The hot product stream of the catalytic partial oxidation reactor 2 is led via line 8 to a heat exchanger 10, in which the hot product stream is used to preheat natural gas fed to the heat exchanger by line 12.

and at col. 8, lines 11-12 and 16-17,

The cooled product stream of the catalytic partial oxidation reactor is removed from the heat exchanger via line 16. ... A portion of the cooled product stream is supplied via line 20 to a desulfurization unit 22.

It is acknowledged in Paper No. 13 that *DeJong et al.* is silent as to the desulfurization unit 22 being a sulfur condenser. The Office fails to appreciate, however, that *DeJong et al.* also does not teach that any elemental sulfur is produced in that process, much less that a condensable amount of elemental sulfur would result. This is in marked contrast to the implicit requirement of Applicant's claims 8-12, 15-17, 21-23 and 25-27 that a condensable amount of elemental sulfur is produced via the claimed apparatus.

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7. Enclosed herewith is the Declaration of Alfred E. Keller as evidence in support of this Response to Office Action, with attached pages from a standard engineering reference book (ENGINEERING DATA BOOK, published by the Gas Processors Suppliers Association, Tulsa, Oklahoma (1998)). The Declaration discusses the teachings of those pages, and provides other pertinent evidentiary facts which clearly establish that the process of *DeJong et al.* would not reasonably be expected by one of ordinary skill in the art to produce a condensable amount of elemental sulfur.

8. The Declaration also establishes that one of ordinary skill in the art when endeavoring to produce useful synthesis gas by a catalytic partial oxidation process would not consider a sulfur condenser to be among the "[s]uitable processes for use in the desulfurization unit for removing sulfur-containing components from the carbon monoxide/hydrogen product.

9. For better clarity as to the positional relationship of the reaction zone and the cooling zone including a sulfur condenser, Applicant has amended claim 8, without narrowing its scope, to recite "a cooling zone including a sulfur condenser for receiving said product from said reaction zone..." instead of "downstream from said reaction zone, at least one cooling zone including a sulfur condenser..." Another non-narrowing amendment to claim 8 has been made in which recitation of injection lines has been omitted in order to simplify the issues in controversy with respect to claims 8, 15, 17 and 25.

No Motivation to Combine *DeJong et al.* and *Kiliany et al.*

10. It is said in Paragraph 3 of Paper No. 13 (and endorsed in the Office Action of June 30, 2003) that it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the sulfur condenser of *Kiliany et al.* for the desulfurization unit 22 of *DeJong et al.* because both units' purposes are for removing sulfur from a product stream coming from an oxidation reactor. This conclusion overlooks or disregards the substantial differences and teaching away in the references. The enclosed Declaration establishes that one of ordinary skill in the art would have no reason to combine the *DeJong et al.* and *Kiliany et al.* references as suggested in the Office Action. A person of ordinary skill in the art would not consider a sulfur condenser a suitable substitute for a conventional desulfurization unit when attempting to produce a substantially sulfur-free synthesis gas product. Moreover, the two processes have different purposes, and marked differences in their feeds, reactors, operating conditions and products.

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Some of the more notable differences are discussed in subparagraphs 4a) - 4c), which follow.

a) **Feeds are Different.** One major incompatibility is that the feeds to the reactors are different. In *Kiliany et al.*, at the tail gas treatment stage, the feed to oxidation reactor 74 appears to be a H₂S rich gas stream. By contrast, *DeJong et al.* discloses an H₂S content in a primarily hydrocarbon feed in an amount of up to about 100 ppm. *DeJong et al.* states that

Hydrocarbon feedstocks used directly from naturally occurring reservoirs in which the sulfur content is significantly above the aforementioned upper limits may preferably be subjected to a partial sulfur removal treatment before being employed in the process of this invention.

This difference in feed composition constitutes strong teaching away from combining the *DeJong et al.* and *Kiliany et al.* references as suggested in the Office Action.

b) **Oxidation Reactors are Different.** The *DeJong et al.* reference discloses a syngas production process operated at a temperature in the range of about 950° to about 1,300°C. Under the conditions of high pressure prevailing in the process, it is said to be necessary to allow the feed gases to contact the catalyst at elevated temperatures in order to achieve the level of conversion required for commercial scale operation (col. 5, lines 35-39). By contrast, the H₂S direct oxidation process of *Kiliany et al.* teaches or suggests the use of lower temperatures in the range of about 180°-350°C (Figs. 2-7). The reactor of *DeJong et al.* is capable of being operated at relatively high space velocities (20,000 - 100,000,000 NI/kg/hr), whereas that of *Kiliany et al.* is operated at a much lower space velocities (2-5000 GHSV). The catalysts employed by the respective references are also different. It would, therefore, not be reasonable to assume that the processes carried out in those reactors are the same. For example, one could not assume that a reactor designed for carrying out the oxidation process of *Kiliany et al.* would be able to withstand the much higher temperatures of *DeJong et al.*'s process.

c) **Products are Different.** The gases emerging from *Kiliany et al.*'s oxidation reactor 74 are elemental sulfur and water, whereas the product of *DeJong et al.*'s reactor 2 is said to be a mixture of carbon monoxide and hydrogen that may include sulfur-containing components.

No Reasonable Expectation of Success

11. As established by the Declaration of Alfred E. Keller, and the attachments thereto, a sulfur condenser is a bulk elemental sulfur removal apparatus that is dependent upon the partial vapor pressure of the elemental sulfur in the feed to the condenser being sufficiently high to permit the sulfur vapor to condensation at a given temperature and pressure. Clearly, the very low

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concentrations of H_2S in the reactor feed contemplated by *DeJong et al.* would be incapable of producing a condensable concentration of elemental sulfur vapor in the syngas product, even if, for the sake of argument, the reaction conditions permitted such conversion to elemental sulfur to occur. Thus, even if the sulfur condenser of *Kiliany et al.* were inserted into the apparatus of *DeJong et al.*, as suggested in the Office Action, one of ordinary skill in the art would not have any reasonable expectation that such combination could succeed in condensing elemental sulfur from the synthesis gas product of *DeJong et al.*

If Combined, Would Defeat the Purpose of the Primary Reference

12. If the desulfurization unit 22 of *DeJong et al.* were to be replaced by a sulfur condenser of *Kiliany et al.*, as suggested in the Office Action with respect to claim 8, a substantially sulfur-free syngas product must emerge from unit 22 in line 24. However, that would be inconsistent with the fact that a sulfur condenser is incapable of producing a substantially sulfur-free outlet gas, as explained in the enclosed Declaration. Clearly, if one were to make the proposed combination it would render the apparatus of *DeJong et al.* incapable of producing a substantially sulfur-free product for use in sulfur sensitive processes.

With respect to claim 21, it is acknowledged in paragraph 3 of Paper No. 13 that *DeJong et al.* is silent to the system comprising a gas reactor having feed inlets, a boiler, a condenser, a heater and a tail gas cleanup unit. Of the claim 21 limitations, this leaves only "a synthesis gas reactor" as being taught by the primary reference, *DeJong et al.* As stated in the foregoing paragraphs, and as made clear by the Declaration of Alfred E. Keller, *DeJong et al.* is not combinable with *Kiliany et al.* because there is no teaching or suggestion in either reference that would lead the artisan to try to combine a synthesis gas reactor with a sulfur plant's tailgas cleanup assembly, or to combine selected apparatus therefrom, as proposed in the Office Action. The artisan, when endeavoring to improve a synthesis gas process that employs a short contact time synthesis gas reactor, would not look to a sulfur plant assembly for instruction. Moreover, if the two references were to be combined as suggested in the Office Action, the resulting apparatus would defeat the stated purpose of the synthesis gas production reactor of *DeJong et al.* As shown in Fig. 1C of *Kiliany et al.*, the product (tailgas) emerging from their final sulfur condenser is ready for incineration and venting to the atmosphere. In contrast, the product gas (synthesis gas) emerging from the desulfurization unit of *DeJong et al.* is meant to be suitable for use in sulfur-sensitive downstream processes.

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13. With respect to claim 25, which depends indirectly from claim 8, if the desulfurization unit 22 comprises a tail gas processing unit that comprises a sulfur absorbing material (col. 8, lines 21-27 of *DeJong et al.*), as stated in paragraph 3 of Paper No. 13, then it could not conceivably also be a sulfur condenser. This ground of rejection with respect to claim 25 appears to be incompatible with the position taken in the Office Action with respect to claim 8.

14. With respect to claim 15, the Office Action (maintaining the reasons given in paragraph 3 of Paper No. 13) is inconsistent and confusing where it states that "*DeJong et al.* discloses a tailgas processing unit downstream from the cooling zone (22) which can be a sulfur condenser..." while at the same time maintaining with respect to claim 8 that the desulfurization unit 22 of *DeJong et al.* can be a sulfur condenser as taught by *Kiliany et al.* This rejection is tantamount to saying that the desulfurization unit 22 can be both the sulfur condenser of *Kiliany et al.* and a tailgas processing unit downstream from itself.

15. It is submitted that claims 9, 11 and 12, each of which depends directly or indirectly from claim 8, are all patentable for at least the same reasons as discussed above for claim 8. Even if *Heck et al.* did teach a mixing zone and an oxygen line (without admitting that such is the case), as suggested in paragraph 4 of Paper No. 13, such teachings by *Heck et al.* would not correct any of the shortcomings of *DeJong et al.* and *Kiliany et al.* which are described above.

16. With respect to claim 10, which depends indirectly from claim 8, even if a thermal barrier were taught by *Dubois et al.* (without admitting that such is the case), as stated in paragraph 5 of Paper No. 13, *DeJong et al.* and *Kiliany et al.* would still not be combinable for the reasons given above.

17. Claim 16, which depends from claim 8, is also believed to be patentable for the same reasons as claim 8. Even if a wire gauze catalyst support were taught by *Goetsch et al.* (without admitting that such is the case), as stated in paragraph 6 of Paper No. 13, the combination of *DeJong et al.* and *Kiliany et al.* would not be possible for the reasons given above.

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No Motivation to Combine *DeJong et al.* and *Heisel et al.*

18. In the final Office Action of June 30, 2003, claims 26-28 continue to be rejected under 35 U.S.C. § 103(a) as being unpatentable over *DeJong et al.* in view of *Heisel et al.*, as presented in the Office Action of December 17, 2002. Applicant respectfully requests reconsideration and withdrawal of this rejection in light of the foregoing discussion regarding *DeJong et al.* It is well known, and the *Heisel et al.* reference also teaches, that in a low-temperature direct oxidation process, when the temperature exceeds approximately 300°C, instead of the oxidation of the H₂S to elemental sulfur, the undesirable combustion of H₂S begins, which leads primarily to the formation of SO₂. As explained in the attached Declaration of Alfred E. Keller, the means for recovering elemental sulfur in *Heisel et al.* is incompatible with the apparatus of *DeJong et al.* for essentially the same reasons as discussed with respect to *Kiliany, et al.* There would be no reasonable expectation at the time of the invention that a condensable amount of elemental sulfur would exist in the product of the *DeJong et al.* process. Therefore, there would be no motivation to combine these references, nor would there be any reasonable expectation of success if they were combined.

19. Applicants respectfully request entry of the amendments, which are only for clarification, to reduce the issues in controversy, to improve claim form, and/or to conform to the Examiner's suggested wording. Withdrawal of the rejections and allowance of all pending claims is respectfully requested.

Conclusion

20. Applicants may have at times referred to claim limitations in shorthand fashion, or may have focused on a particular claim element. This discussion should not be interpreted to mean that the other limitations can be ignored or dismissed. The claims must be viewed as a whole, and each limitation of the claims must be considered when determining the patentability of the claims. Moreover, it should be understood that there may be other arguments with respect to patentability which have yet to be raised, but which may be raised in the future. The format of this Amendment and Response to Office Action is believed to conform with the Revised Amendment Practice as described in "Changes To Implement Electronic Maintenance of Official Patent Application Records," 68 Fed. Reg. 38611 (June 30, 2003).

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All of the pending claims are believed to be free of the prior art, and reconsideration and withdrawal of the rejections are respectfully requested. If a telephone conference would facilitate the resolution of this matter, the Examiner is invited to telephone the undersigned representative. Should any fees have been inadvertently omitted, or if any additional fees are required or have been overpaid, please appropriately charge or credit those fees to Deposit Account Number 03-2769 of Conley Rose, P.C., Houston, Texas, and consider this a petition for any necessary extension of time.

Respectfully submitted,



Carol G. Mintz
PTO Reg. No. 38,561
Conley Rose, P.C.
P.O. Box 3267
Houston, Texas 77253-3267
Tel 713-238-8000
Fax 713-238-8008

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